Journal of Alloys and Compounds 480 (2009) 126–127

Contents lists available at ScienceDirect

Journal of Alloys and Compounds

journal homepage: www.elsevier.com/locate/jallcom

Electron spin resonance of dense Yb-based heavy-fermion compounds: New experimental data

V.A. Ivanshin [a,*], A.A. Sukhanov [b], D.A. Sokolov [c,d], M.C. Aronson [d,e,f], S. Jia [g], S.L. Bud'ko [g], P.C. Canfield [g]

[a] MRS Laboratory, Kazan State University, Kremlevskaya str. 18, 420008 Kazan, Russia
[b] E.K. Zavoisky Physical-Technical Institute, Sibirskij trakt 10/7, 420049 Kazan, Russia
[c] School of Physics and CSEC, The University of Edinburgh, Erskine Williamson Building, The King's Buildings Mayfield Road, Edinburgh EH9 3JZ, United Kingdom
[d] Department of Physics, The University of Michigan, Ann Arbor, MI 48109-1120, USA
[e] Condensed Matter Physics and Materials Science Department, Brookhaven National Laboratory, Upton, NY, USA
[f] Department of Physics and Astronomy, Stony Brook University, Stony Brook, NY 11794-3800, USA
[g] Ames Laboratory, U.S. Department of Energy, and Department of Physics and Astronomy, Iowa State University, Ames, IA 50011, USA

ARTICLE INFO

Article history:
Received 30 June 2008
Received in revised form
24 September 2008
Accepted 25 September 2008
Available online 22 November 2008

PACS:
71.27.+a
76.30.−v
78.30.Ly

Keywords:
Electron spin resonance
Heavy fermions
Yb-compounds

ABSTRACT

We report the more recent advances in electron spin resonance (ESR) of few undoped Yb-based intermetallic compounds with heavy fermions (HF). The X-band ESR spectra of the Kondo lattices YbBiPt, $YbRh_2Pb$, and YbT_2Zn_{20} (T = Fe, Co) are presented. A comparison with earlier ESR studies in $YbRh_2Si_2$ and $YbIr_2Si_2$ shows that the exchange interactions between the Yb 4f electrons and relevant conduction electron (d-, s-, or p-like) bands as well as the hybridization crystalline electric field (CEF) effects should be taken into account in order to develop a reliable model of spin dynamics in the Yb-based HF systems.

1. Introduction

ESR has been used the last three decades as a powerful method to investigate very different HF compounds [1]. Usually, it is necessary to dope HF systems with small concentrations of rare-earth ions in order to detect any measurable ESR signal because of a very fast spin-lattice relaxation of the Kondo ion. However, the ESR measurements on the $YbRh_2Si_2$ and $YbIr_2Si_2$ crystals [2–4] demonstrate the observability of the ESR line in a dense Kondo lattice system. Intriguing physical properties of these compounds give unique possibility to explore the possible interplay and the role of the Kondo effect, quantum criticality, intermediate valence, Rudermann–Kittel–Kasuya–Yoshida (RKKY) interaction, CEF, and Fermi surface effects using the ESR method. Although the origin of the ESR signals in both systems remained a mystery, it has been very recently related to the existence of ferromagnetic fluctuations [5]. To our best knowledge, we present in this communication the first ESR spectra of several other undoped Kondo lattices YbBiPt, $YbRh_2Pb$, and YbT_2Zn_{20} (T = Fe, Co).

2. Experimental results and discussion

The ESR measurements were performed using a standard ESM/plus Bruker X-band (frequency ∼9.45 GHz) spectrometer. The temperature was varied between $4.4\,K \le T \le 300\,K$ by using a He-flow cryostat. We used single-crystalline platelets (0.5–0.8 mg weight; 2–4 mm^2 surface area) of all investigated intermetallics, the preparation, magnetic, transport properties, and the CEF effects of which have been described elsewhere [6–8]. Fig. 1 shows the "raw" ESR spectra which we succeeded to observe in YbBiPt and $YbRh_2Pb$ at $T = 4.4$ K with the same experimental conditions at the resonance field position H_{res} near 2150 Oe similar to the cases of $YbRh_2Si_2$ and $YbIr_2Si_2$ [2–4]. An intensity of the cavity background signals at $H_{res} \sim 3300$ Oe was comparable with that of both detected ESR spectra. The ESR peak-to-peak line width ΔH_{pp} which is marked by vertical arrows in Fig. 1 increased at this temperature from ∼200 Oe

* Corresponding author. Tel.: +7 843 2315175; fax: +7 843 2387201.
E-mail address: Vladimir.Ivanshin@ksu.ru (V.A. Ivanshin).

0925-8388/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.jallcom.2008.09.172